HITACHI

GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

P.O. Box 780
3901 Castle Hayne Road, M/C A-55
Wilmington, NC 28402 USA

T 910.675.6192
F 910.362.6192
rick.kingston@ge.com

MFN 08-243
Supplement 1

Docket No. 52-010

September 19, 2008

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: Response to Portion of NRC RAI Letter No. 207 Related to ESBWR Design Certification Application - DCD Tier 2 Section 3.8 - Seismic Category I Structures; RAI Number 3.8-120 S01

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated January 14, 2008 (Reference 1). RAI Number 3.8 120 Supplement 1 is addressed in Enclosure 1.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

References:

1. MFN 08-497 from Chandu Patel, Project Manager, ESBWR/ABWR Projects Branch 1, Division of New Reactor Licensing, Office of Nuclear Reactor Regulation, to Robert E. Brown, *Request for Additional Information Letter No. 207 Related to ESBWR Design Certification Application*, dated May 27, 2008

2. MFN 08-243 from James C. Kinsey to the U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 124 Related to ESBWR Design Certification Application, Seismic Category I Structures, RAI Numbers 3.8-118, 3.8-120, 3.8-121, 3.8-122 & 3.8-123*, dated April 3, 2008

3. MFN 08-209 Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 124 Related To ESBWR Design Certification Application*, dated January 14, 2008

Enclosure:

1. Response to Portion of NRC RAI Letter No. 207 Related to ESBWR Design Certification Application - DCD Tier 2 Section 3.8 - Seismic Category I Structures; RAI Number 3.8-120 S01

cc:	AE Cubbage	USNRC (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF	0000-0086-5306 (RAI 3.8-120 S01)

ENCLOSURE 1

MFN 08-243
Supplement 1

Response to Portion of NRC RAI Letter No. 207
Related to ESBWR Design Certification Application

DCD Tier 2 Section 3.8 – Seismic Category I Structures

RAI Number 3.8-120 S01

For historical purposes, the original text of RAI 3.8-120 and the GEH response are included. The attachments (if any) are not included from the original response to avoid confusion.

NRC RAI 3.8-120

The staff notes that DCD Revision 4 Appendix 3G presents revisions in the various design load tables and stress result tables for all of the structures. As a result, the staff requests that the following items be addressed:

(a) DCD Tier 2, Chapter 3, Revision 3 to Revision 4 Change List (Appendices 3G - 3L) indicates that the numerous changes are due to "reanalysis incorporating updated design conditions" and "due to reanalysis reflecting the change of hydrodynamic load." Provide an explanation for the expressions: "updated design conditions" and the "change of hydrodynamic load."

(b) The stress result tables compare the calculated stress results against allowable stresses. In order to do so, the specific material properties must have been already selected or assumed. However, in a number of cases presented in DCD Revision 4, the grade of the steel material is not identified. For example, Section 3.8.3 does not identify the grade for ASTM A-572, A-516, and A-668. The steel material grade needs to be specified because it defines the yield strength from which the allowable stresses are obtained. The staff requests that applicable sections of the DCD be revised to identify the material grade for the various steel materials used so that they will be consistent with the material properties assumed in the design.

(c) DCD Section 3.8.3.6.3 indicates that the reactor shield wall may be constructed from steel material ASTM A-709 HPS 70W. DCD Section 3.8.3.1.3 indicates that the plate thickness varies along the elevation and is 6-5/16 in., 8-1/4 in., and 10-1/4 in. In addition, DCD Figure 3G.1-58 shows the variation in thickness of the steel material of the reactor shield wall. Since ASTM A-709 HPS 70W is not manufactured in thicknesses greater than 4 inches, explain whether one of the other material choices in the DCD will be used or how the analysis and design considers this limitation. The staff has also raised a concern under RAI 5.2-50 related to welding the A-709 material to the containment steel liner and the acceptability of a code case for this type of welding. GEH needs to resolve this issue as well.

GEH Response

(a) In the change list reference to "updated design conditions" mean the change of seismic category of the CB for the portions above grade. Due to seismic re-classification from C-II to C-I, seismic loads, dead loads, wind loads and tornado loads and design details were modified accordingly.

The reference to "the change of hydrodynamic load" means DW Head and GDCS pool local analysis models input of hydrodynamic loads, and the NASTRAN integral model input of hydrodynamic loads for the RPV reactions, GDCS Pool reactions are changed to maintain consistency with the results of the hydrodynamic response analysis described in DCD Appendix 3F.

(b) The grades of materials in DCD Tier 2 Subsection 3.8.3.6 that have been considered in the design documented in Appendix 3G, are ASTM A-516 Gr. 70 and A-709 HPS 70W. ASTM A-668 Gr. F or Gr. G will be kept as forging material option for Reactor Shield Wall. ASTM A-572 is no longer used for the structures referenced in DCD Tier 2 Subsections 3.8.3.6.1 through 3.8.3.6.5. ASTM A-36 is used for the stiffeners for diaphragm floor, vent wall and GDCS pool.

Thus in DCD Tier 2, Gr. 70 will be added to A-516 material in Subsections 3.8.3.6.2 and 3.8.3.6.3. Gr. F or Gr. G will be added to A-668 in Subsection 3.8.3.6.3. A-572 will be deleted from Subsections 3.8.3.6.1, 3.8.3.6.4 and 3.8.3.6.5. A-36 will be added as a material for stiffeners in Subsections 3.8.3.6.1, 3.8.3.6.4 and 3.8.3.6.5. Gr. 50 or 65 will be added to A-572 material in Subsection 3.8.3.6.6.

ASTM A-36 is used as the bottom steel plates of the RB composite floor slabs, for which the stresses are compared with the allowable values in the DCD Tier 2 Tables 3G.1-51 through 3G.1-55. There is no grade specification for A-36. DCD Tier 2 Subsection 3G.1.5.2.3.3 will be clarified.

(c) The portion of the reactor shield wall using ASTM A709-HPS 70W material with thicknesses exceeding 4 inches may be fabricated using one of the multiple layer construction techniques identified in the ASME Section VIII, Division 1 Code.

Layered construction has been used in the pressure vessel industry since the early 1940's. Experimental work and actual construction have demonstrated that the fabrication methods used prove that the multiple layers can and will respond to applied loads as solid homogenous steel. In fact, in military applications, multiple-layer technology has been in use since the early 1800's. There is no doubt that the methodology is valid and effective.

There are four common types of layered construction used in the pressure vessel industry. These are identified in Section VIII of the ASME Boiler and Pressure Vessel Code as:

a) Concentric Wrapped,

b) Coil Wound,

c) Shrink Fit,

d) Spiral Wound.

All of these fabrication methods have been used successfully for more than 50 years.

The main purpose of multiple layer construction is to fabricate shells from high strength thin plate materials to obtain a thickness that is not possible with single plate shells of the same strength.

Multiple layer construction has been very effective for cylindrical pressure vessels more than 16 inches thick. The construction techniques allow the multiple layer shells to act as a solid wall.

The ASME Boiler and Pressure Vessel Code has included rules for the design and construction of multiple layer pressure vessels since the Winter 1978 Addenda to Section VIII. The rules were never added to Section III because of the stoppage in new construction at that time. The Section VIII code rules provide for tightness between layers to assure the multiple layer shell acts in the same manner as a solid wall shell. The construction rules are provided in part ULW of Section VIII, Division 1.

The issue of welding the ASTM A 709 material to the containment shell liner and the acceptability of an ASME Code Case for welding this material without postweld heat treatment is addressed in RAI 5.2-20, Supplement 2. Welding of layers will comply with Case N-763. The Case addresses welding of A 709 HPS 70W to any other material. A joint between HPS70W and any other material must be separately qualified in accordance with ASME Section XI, as described in paragraph 7.0 of Case N-763. Preheat, impact testing, and hydrogen control will comply with N-763.

DCD Impact

Markups of DCD Tier 2 Subsections 3.8.3.6.1, 3.8.3.6.2, 3.8.3.6.3, 3.8.3.6.4, 3.8.3.6.5, 3.8.3.6.6, and 3G.1.5.2.3.3 were provided in MFN 08-243.

NRC RAI 3.8-120, Supplement 1

Part (b):

1. *In Part (b) of the RAI response, dated April 3, 2008, GEH revised the applicable sections of DCD 3.8.2 and 3.8.3 to identify the material grade for the various steel materials used so that they will be consistent with the material properties assumed in design. However, for all locations in DCD 3.8.3 where the material A-709 HPS 70W is given, a footnote was added which refers to ASME Code Case N-763. Since DCD 3.8.3 applies to the containment internal structures, which are designed using the ANSI/AISC N690 specification, please explain the reason for referencing ASME Code Case.*
2. *The GEH response to RAI 5.2-50 indicates that A-709 HPS 70W is being added to the DCD as an option for the containment liner. Use of A-709 HPS 70W material for containment liner is currently under review by the ASME Standards Committee under a new code case (ASME Code Case N-763). As such, this needs to be approved by the ASME Code before it can be used for containment liner. The staff requests GEH to explain why an option is being given for use of the A-709 HPS 70W material. Also, based on the proposed revisions to the DCD, it is not clear as to what portions of the containment liner and appurtenances will use the currently specified ASME SA-516 Gr.-70 or the newly proposed material of ASTM A-709 HPS 70W. These should be clearly explained.*
3. *If the A-709 HPS 70W material will also be used for the containment liner and appurtenances, then GEH is requested to explain how the change in material (including the much higher yield strength) affects the analysis and design of the containment. This should include the effects of this new material on the overall finite element analysis of the entire containment structure for mechanical and thermal loads as well as the localized design of the liner and liner anchorages.*

Part (c):

In Part (c) of the RAI response, dated April 3, 2008, GEH indicated that the portion of the reactor shield wall using ASTM A709 HPS 70W with thicknesses exceeding 4 inches may be fabricated using one of the multiple layer construction techniques identified in ASME Code, Section VIII, Division 1. The staff notes that the reactor shield wall is not a pressure vessel, and if it was a pressure vessel for use in nuclear power plants, it would be subject to the rules of ASME Section III not Section VIII. 10 CFR 50.55a which is the basis for endorsing applicable sections of the ASME Code does not endorse ASME Section VIII. If GEH still wants to use some other method (such as the ASME Code, Section VIII, Division 1) rather than a conventional engineering design approach for treating multiple layers of cylindrical structures, then GEH is requested to fully describe the specific analytical approach that will be used and to demonstrate the technical adequacy of the approach. Simply referring to some Code and stating that using the construction techniques of that Code allows the multiple layer shells to <u>act as a solid wall</u> is not sufficient.

GEH Response

Part (b):

1. The reason for referencing ASME Code Case N-763 for containment internal structures is because some of the internal structures made of A-709 HPS 70W material are attached to the containment liner plates. The current ASME Section III, Division 2, Subsection CC does not permit A-709 HPS 70W as attachments to liners. ASME Code Case N-763 provides controls for ensuring satisfactory connections when A-709 HPS 70 W is attached to the containment liner plates.
2. The option of using A-709 HPS 70W material is provided to eliminate post weld heat treatment when the design of the containment requires thicker liner material. DCD Tier 2 Figure 3G.1-48 identifies the local areas where this material is to be installed.
3. The A-709 HPS 70W material is only used in local areas needed by design as shown in DCD Tier 2 Figure 3G.1-48, i.e. at containment liner/diaphragm floor and containment liner/vent wall/RPV support brackets connections. Changing the material from SA-516 Gr. 70 to A-709 HPS 70W in these local areas has no impact on the overall finite element analysis since both materials are carbon steel having the same properties for modulus of elasticity and Poisson's ratio. The analysis results obtained are therefore equally applicable to both materials in the localized design of the liner and liner anchorages. DCD Tier 2 Table 3G.1-12 will be updated to clarify the liner Young's modulus used for these local areas in the design calculations.

   The discussion below outlines the effects of the liner material change on the nonlinear analyses performed for 1) the DBA Thermal Stresses used to establish thermal stress ratios used in the RCCV design and 2) the Pressure Fragility Analysis (Over-Pressurization) used for containment ultimate capacity and PRA assessments. Both analyses considered the actual thickness of these thickened sections, so any effect will be associated with a change in the material properties. The A-709 material has a much higher yield stress than the SA-516 material (70 ksi versus 38 ksi minimum specifications). The ductility of A-709 is slightly less than that for SA-516 (19% versus 21% for 2" specimens). As stated above, both materials are carbon steel having the same modulus of elasticity and Poisson's ratio.

   DBA Thermal Stresses

   The DBA Thermal Stress analyses provide input, in the form of thermal stress ratios as discussed in DCD Tier 2 Section 3.8.1.4.1.3, to the RCCV structural design. The thermal stress ratios allow factoring the linear design-based analyses for thermal loads to allow for nonlinear effects of cracking that reduces and redistributes thermal induced stress. These analyses use design based (lower bound) material property data. While the response in the liner should not significantly affect the section forces and moments across the full thickness of the RCCV reinforced concrete wall, the connections of the internal steel structures to the RCCV and associated thickened sections of the liner represent areas of increased section demands due to additional restraints. However, because the elastic modulus and Poisson's ratio of the two materials is essentially the same, the thermal induced forces will be the same, and the DBA thermal analyses does not consider any loading except for thermal. Thus, the only effect this change in material will have on these analyses would be due to the higher yield stress of the A-709 material that is replacing the SA-516 material.

Figures 3.8-120(1) and 3.8-120(2) provide plots for the response of the liner materials at the Diaphragm Floor connection from the DBA thermal analysis at times of 6 minutes and 72 hours, respectively. These figures show contour plots for the Maximum Principal Stresses and the Accumulated Plastic Strain for the thickened sections and a part of the connected liners. General yielding in the 6.4 mm (1/4") thick liner material and some slight localized yielding in the 38 mm (1 ½") thick section near the connection with the thinner liner develops by 6 minutes due to compressive stress as the liner gets heated relative to the RCCV concrete. Using A-709 for the thickened section would likely reduce or eliminate the yielding in the thickened section. However, because the extent of this yielding is localized and the magnitude of yielding is small (plastic strain of about .03%), this is considered to have a negligible effect on the section forces calculated across the complete RCCV wall near this region.

Figures 3.8-120(3) and 3.8-120(4) provide plots for the response of the liner materials at the Vent Wall connection from the DBA thermal analysis at times of 6 minutes and 72 hours, respectively. These figures show contour plots for Temperature, the Accumulated Plastic Strain, the Maximum Principal Stresses, and the Minimum Principal Stresses for the thickened sections and a part of the connected liners. Again, general yielding in the liners develops early due to compressive stresses, as the liner gets hot under the accident temperature history relative to the concrete. Here some slight localized yielding in the thickened section develops at the connections with the Reactor Pressure Vessel support brackets. Because of the localized extent and small amount of plastic strain in this thickened section, it is concluded that replacing the SA-516 material with the higher strength A-709 material will not significantly affect the thermal ratios calculated across the complete RCCV wall section near this connection.

Pressure Fragility Analyses

The Fragility analyses for ultimate capacity due to over-pressurization in DCD Tier 2 Appendix 19C determined that the tearing of the RCCV liner would occur first at the connection of the RCCV wall with the top slab. The Level C pressure capacity calculations, documented in DCD Tier 2 Appendix 19B, also identified that tearing of the liner at the connection of the RCCV wall with the top slab was the limiting factor for the Level C pressure capacity. An evaluation is performed to assess whether replacing the thickened portion of the liners with A-709 would affect this failure mode. Since the A-709 has higher yield capacity than the SA-516, the change will not affect the thickened portion directly. The assessment considers whether a lower ductility of the connection of the thinner liner to the thickened portion could shift the liner tearing mode from the RCCV wall to top slab connection to this connection at a lower internal pressure. Figure 3.8-120(5) plots contour plots for Maximum Principal Stress and Accumulated Plastic

Strain for the liners in the upper drywell at a load factor of 7 on design pressure for the median property analysis of the 260 °C (500 °F) steady state temperature condition. This plot shows that the yielding has not developed in the thickened portion or at the connection with the thickened portion at this load level. This pressure load is beyond that which causes tearing to develop in the liner at the connection of the RCCV wall and top slab. Figure 3.8-120(6), which is Figure 19B-4 extracted from DCD Tier 2 Appendix 19B, shows a similar plot for the liner response under the Level C analysis conditions. Again, the strains at the connections of the thinner liner to the thickened sections are much smaller than those at the RCCV wall to top slab connection, and changing the material of the thickened section would not cause the calculated Level C capacity to change due to a shifting of the failure location because of slightly lower ductility. Likewise, replacing the 50 mm (1 15/16") thick portion at the VW connection with A-709 will not affect the calculated limiting pressure due to liner tearing at the RCCV wall connection with the top slab. Therefore, replacing the thickened portions of the liner with A-709 material will not affect the calculations that have been performed for the pressure fragility nor the Level C pressure capacity of the RCCV.

Part (c):

The RSW thickness above EL. 10000 mm will be 160 mm (6 5/16") and will be constructed from one plate of A-516 material (not multiple cylindrical sections). Below this elevation however, A-709 or A-668 material will be used. A-709 is limited to 4" thicknesses and therefore, the RSW below elevation 10000 mm will need to be constructed from multiple layers. The concern is what is the effect of modeling the multiple cylindrical shells as one shell. This effect is not considered to be significant for the overall RSW response because (1) DCD Tier 2 Figure 3G.1-58 (RSW) shows that the upper 2/3 height of the RSW is constructed from one layer of shell and only the lower bottom 1/3 region would have to be constructed from multiple layers and (2) DCD Tier 2 Table 3G.1-40 shows that the most critical stress ratio (calculated to allowable) is 0.708 which provides substantial margin.

Furthermore, for seismic evaluation, shear loads are distributed to the RSW elements in such a manner that the sides of the cylinder carry the maximum shear force and diminish to the 0 and 180 degree azimuth location. In this type of loading distribution, treating the RSW as multiple cylinders or a single monolithic cylinder will not affect the stress results. For local load effects, the most significant local load on the RSW is due to annulus pressurization (AP). The AP load that is closest to the multiple cylindrical section of the RSW is due to the RWCU AP load. The RWCU AP load distribution is included in Table 3.8-120(1). As indicated in Table 3.8-120(1), the peak pressure occurs at azimuth 0 degrees at about elevation 17000 to 17400 mm. This occurs within the single cylindrical section of the RSW region. This pressure rapidly diminishes circumferentially and more importantly diminishes vertically so that the peak pressure at the multiple cylindrical RSW is less than 20% of the peak pressure at elevation 17000 to 17400 mm. Furthermore, at the multiple cylindrical portion of the RSW, the radial pressure distribution in the circumferential direction is essentially constant. For pipe break loads, these occur in the upper region of the RSW and by the time the overall shear and moment reach the lower region, the localized load will be more uniformly distributed as in the seismic case.

DCD Impact

DCD Tier 2 Table 3G.1-12 will be revised as shown on the attached mark-up. Verified DCD changes associated with this RAI response are identified in the enclosed DCD markup by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(if any) may not be fully developed and approved for inclusion in DCD Revision 6.

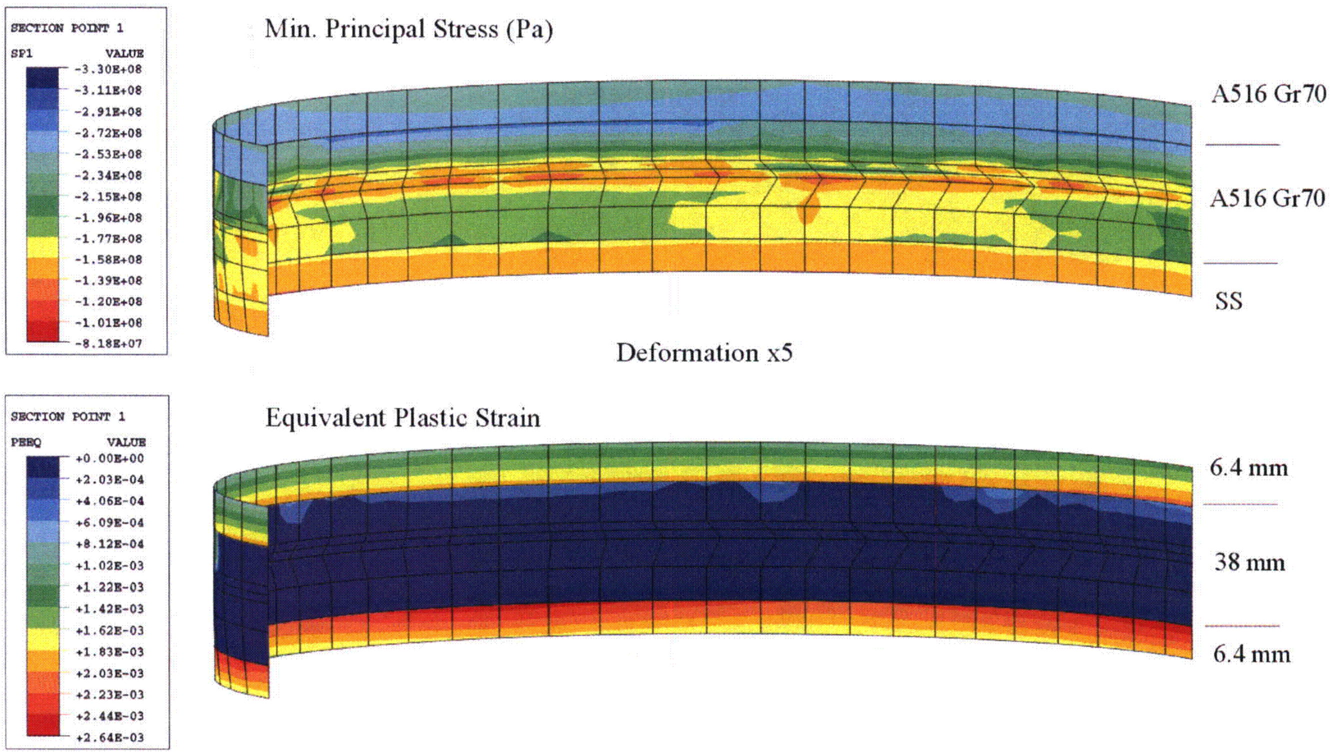

Figure 3.8-120(1) Liner Response at Diaphragm Floor Connection, DBA Thermal Stress at 6 Minutes

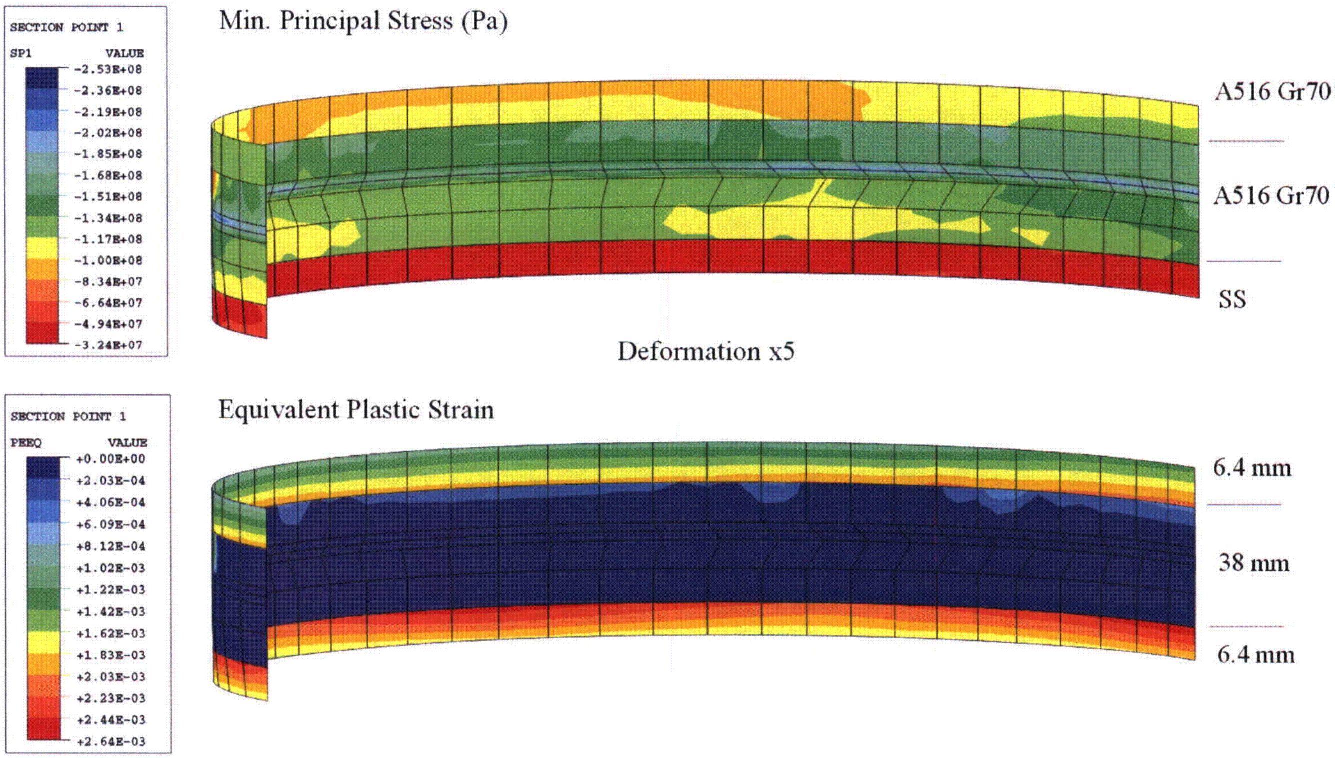

Figure 3.8-120(2) Liner Response at Diaphragm Floor Connection, DBA Thermal Stress at 72 Hours

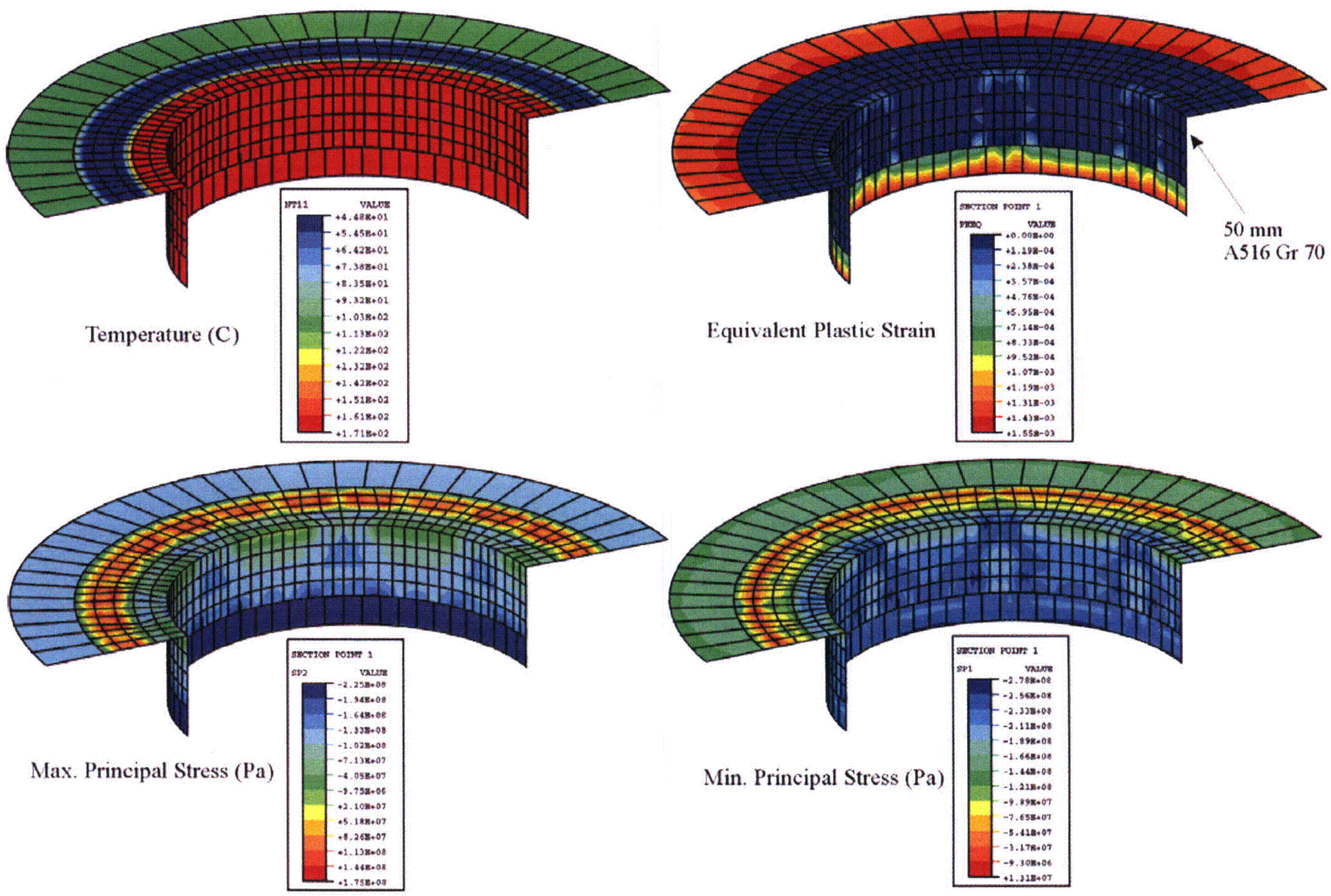

Figure 3.8-120(3) Liner Response at Vent Wall Connection, DBA Thermal Stress at 6 Minutes

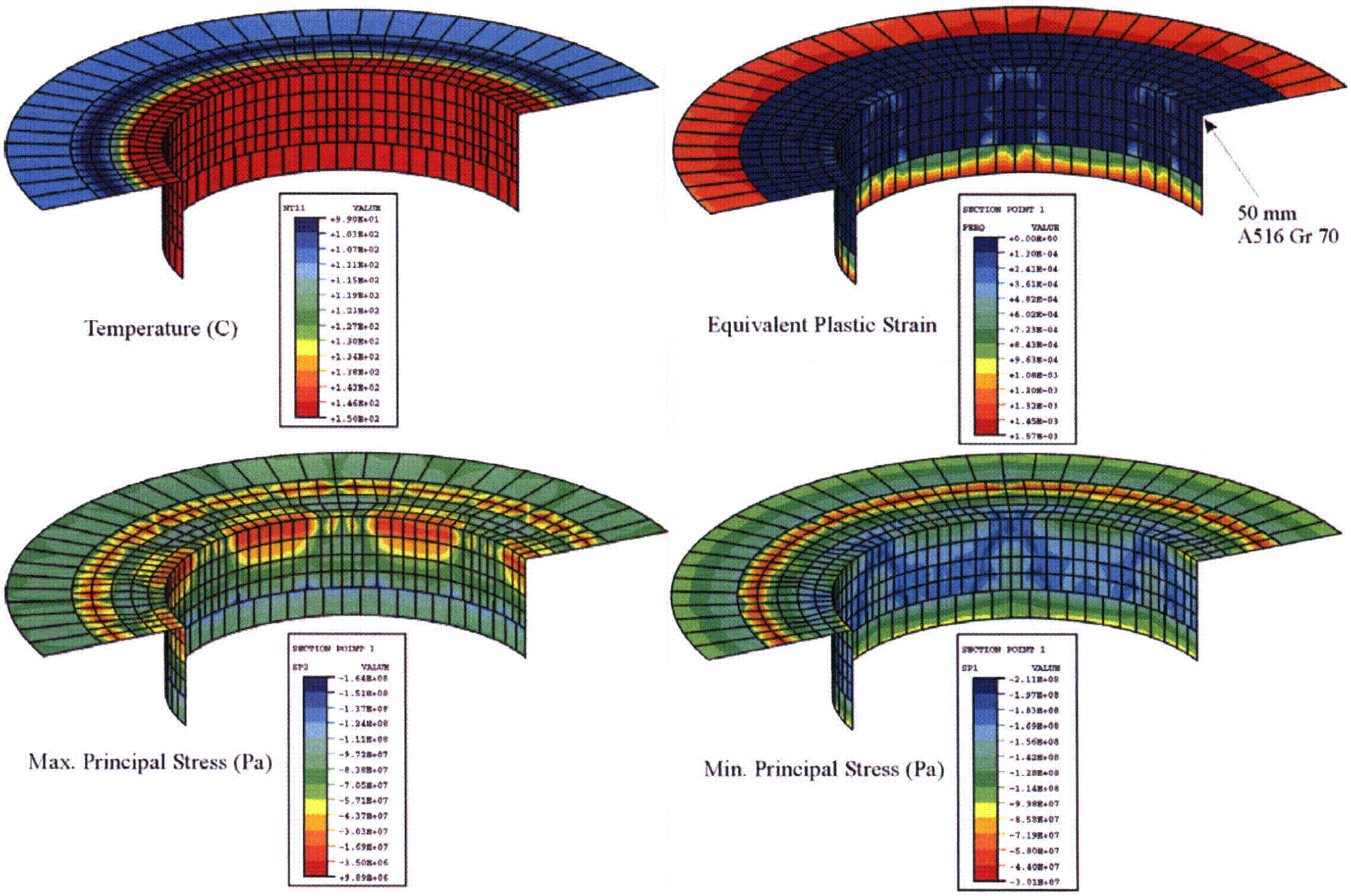

Figure 3.8-120(4) Liner Response at Vent Wall Connection, DBA Thermal Stress at 72 Hours

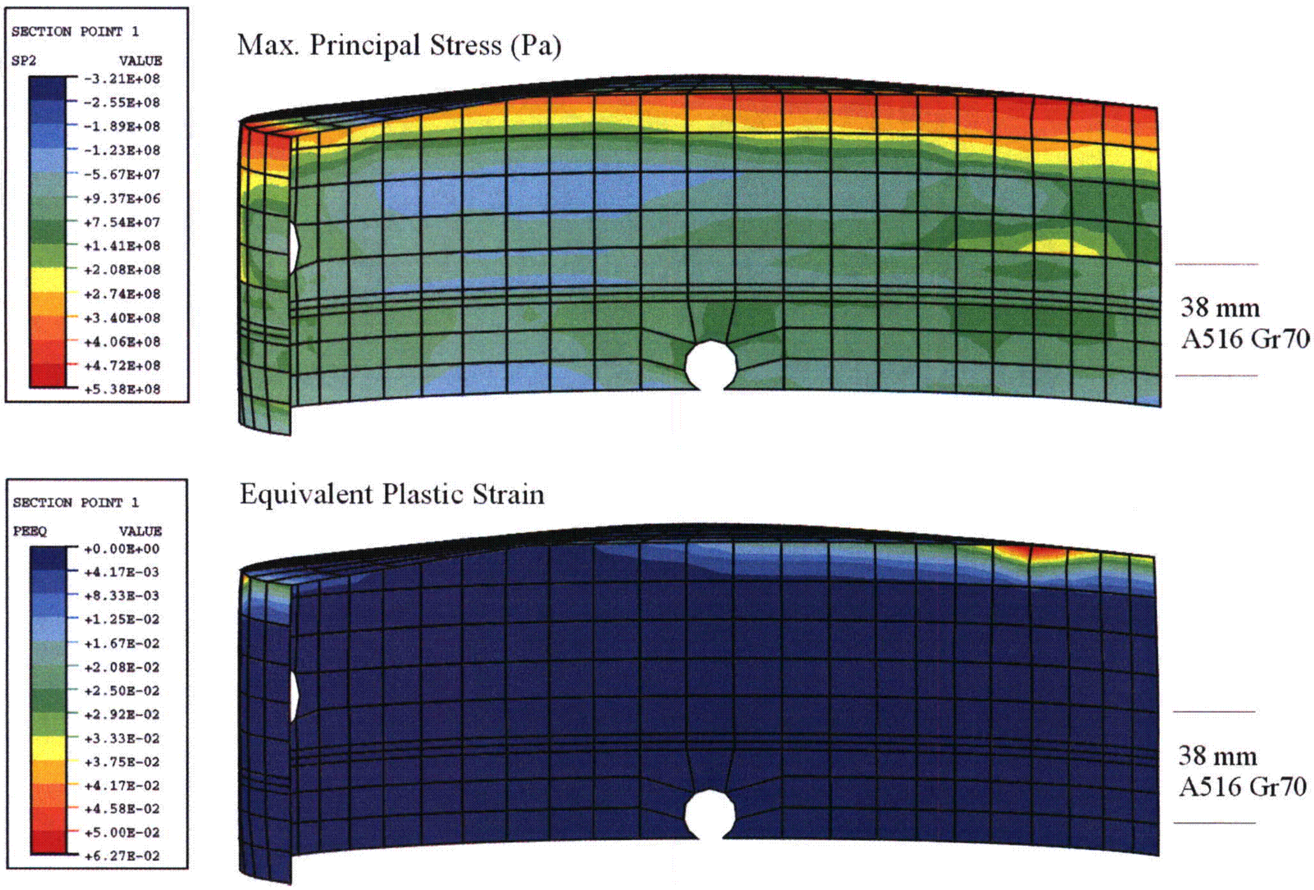

Figure 3.8-120(5) Liner Response in Upper Drywell, Fragility Analysis, 500°F Median Values, Load Factor = 7

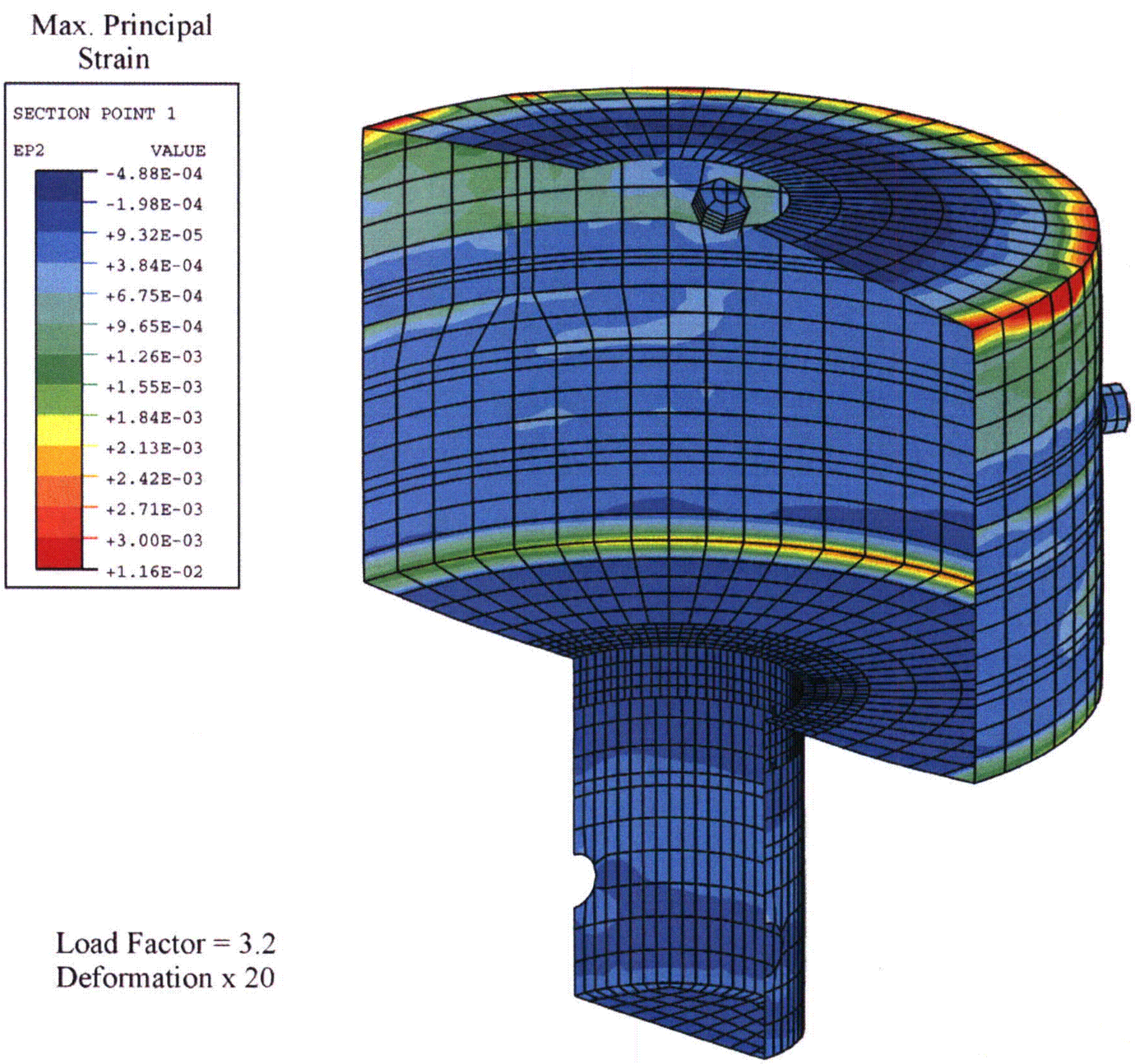

Figure 3.8-120(6). Liner Response in Upper Drywell, Level C Analysis, Load Factor = 3.2

Level	Elev.	Cell #	10	11	12	13	14	15	16	17
		θ	0 – 0.07	0.07 – 0.14	0.14 – 0.21	0.21 – 0.35	0.35 – 0.79	0.79 – 1.57	1.57 – 2.36	2.36 – 3.14
17	24.180	Press	0.185	0.184	0.184	0.184	0.181	0.165	0.155	0.163
		Time	0.018	0.018	0.018	0.018	0.018	0.025	0.025	0.036
16	23.162	Press	0.170	0.170	0.169	0.166	0.169	0.165	0.157	0.167
		Time	0.018	0.018	0.018	0.018	0.015	0.025	0.031	0.036
15	21.293	Press	0.180	0.179	0.181	0.179	0.191	0.160	0.155	0.168
		Time	0.008	0.008	0.008	0.008	0.011	0.015	0.031	0.042
14	19.425	Press	0.239	0.229	0.226	0.222	0.195	0.160	0.158	0.172
		Time	0.006	0.006	0.006	0.006	0.008	0.018	0.054	0.042
13	19.085	Press	0.189	0.222	0.230	0.227	0.203	0.160	0.160	0.173
		Time	0.006	0.006	0.006	0.006	0.008	0.018	0.054	0.042
12	18.745	Press	0.250	0.235	0.231	0.224	0.204	0.160	0.162	0.174
		Time	0.006	0.006	0.006	0.006	0.008	0.018	0.054	0.042
11	18.405	Press	0.257	0.249	0.234	0.226	0.200	0.160	0.164	0.176
		Time	0.004	0.004	0.004	0.004	0.008	0.018	0.054	0.042
10	18.065	Press	0.339	0.301	0.268	0.251	0.194	0.160	0.165	0.177
		Time	0.004	0.004	0.004	0.004	0.008	0.018	0.049	0.042
09	17.725	Press	0.566	0.415	0.317	0.270	0.188	0.160	0.167	0.178
		Time	0.004	0.004	0.004	0.004	0.008	0.018	0.049	0.042
08	17.385	Press	**1.521**	0.679	0.389	0.277	0.184	0.161	0.168	0.179
		Time	0.003	0.004	0.004	0.004	0.008	0.015	0.049	0.042
07	17.045	Press	0.564	0.405	0.306	0.256	0.184	0.163	0.170	0.180
		Time	0.003	0.003	0.003	0.004	0.008	0.015	0.049	0.042
06	16.705	Press	0.226	0.223	0.221	0.217	0.209	0.167	0.175	0.184
		Time	0.006	0.006	0.006	0.006	0.011	0.015	0.049	0.042
05	14.445	Press	0.169	0.170	0.170	0.171	0.172	0.171	0.177	0.153
		Time	0.068	0.068	0.068	0.068	0.068	0.061	0.049	0.189
04	12.185	Press	0.182	0.181	0.181	0.181	0.180	0.175	0.176	0.190
		Time	0.068	0.068	0.068	0.068	0.068	0.068	0.049	0.042
03	9.925	Press	0.182	0.181	0.181	0.182	0.181	0.175	0.175	0.187
		Time	0.068	0.068	0.068	0.068	0.068	0.068	0.036	0.042
	7.665									

Table 3.8-120(1). Peak Annulus Pressures, RWCU Break

Table 3G.1-12

Material Constants for Design Calculations

			Reinforced Concrete		Steel		
		Temperature (°C)	Basemat f'c=4000psi 27.6MPa	Others f'c=5000psi 34.5MPa	Carbon Steel Liner	Stainless Steel Liner	Structural Steel
Young's Modulus (MPa)	**Temperature Loads**	<21	2.49×10^{4}	2.78×10^{4}	2.00×10^{5}		
		93	1.81×10^{4}	2.03×10^{4}			
		204	1.62×10^{4}	1.81×10^{4}			
	Other Loads		2.49×10^{4}	2.78×10^{4}	2.00×10^{1}*		2.00×10^{5}
Poisson's Ratio			0.17		0.3		
Thermal Expansion (m/m°C)			9.90×10^{-6}		1.17×10^{-5}	1.52×10^{-5}	1.17×10^{-5}
Weight Density (MN/m^3)			0.0235		0.0770		

* Except for the local thickened portions of the liner where the diaphragm floor, vent wall and RPV support brackets are attached. The full value of theYoung's modulus is considered for these thickened liners.